Canadian Wastewater Survey, April 1 to November 30, 2021

Released at 8:30 a.m. Eastern time in The Daily, Thursday, January 20, 2022

Measuring the COVID-19 virus (SARS-CoV-2) through wastewater analysis

With the emergence of the Omicron variant, Canada finds itself in another COVID-19 surge, and most provinces and territories are reporting infections in record numbers. Since fall 2020, Statistics Canada (StatCan) has partnered with the Public Health Agency of Canada (PHAC) to develop methods that detect and monitor levels of SARS-CoV-2, the virus that causes COVID-19, in the wastewater of five cities (Metro Vancouver, Edmonton, Toronto, Montréal and Halifax).

In its commitment to keep Canadians informed, StatCan is releasing a preliminary dataset from the Canadian Wastewater Survey (CWS), covering the period from April 1 to November 30, 2021. The first case of Omicron variant in Canada was reported at the end of November 2021, and the variant is therefore not represented in this dataset. StatCan will update wastewater data on a regular basis, as results become available, in order to keep Canadians informed as the emergence of this new COVID-19 variant and the rollout of COVID-19 vaccines continue to influence the course of the pandemic in Canada and worldwide.

Every day, wastewater from Canadian households enters the sewer system carrying chemicals, drugs, and viruses flushed out by our bodies. Using techniques from a field of study called wastewater-based epidemiology, wastewater can be analyzed to estimate the total amount of these substances collectively excreted by the people using the sewer system.

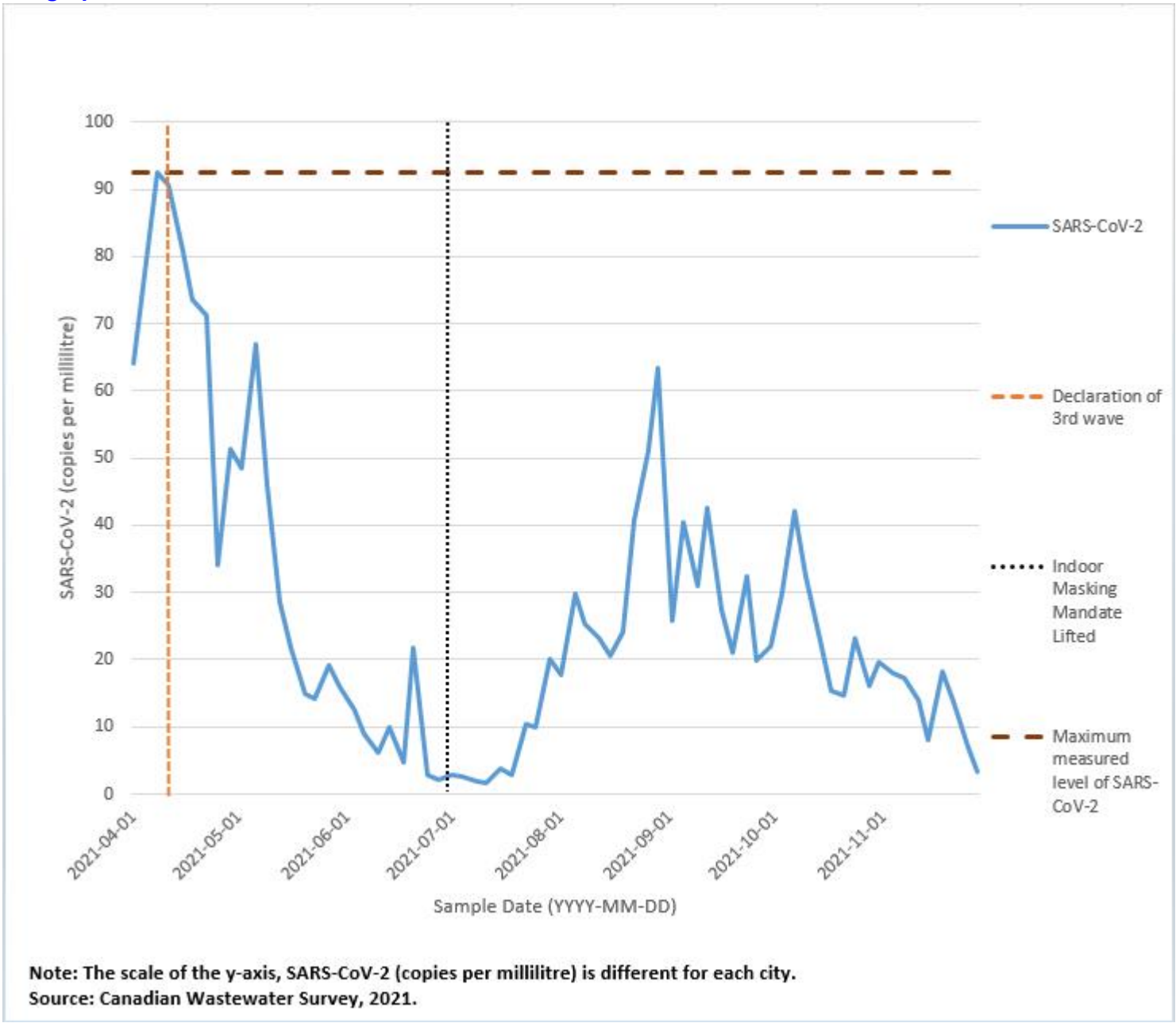
In general, wastewater results from the current reference period show a consistent pattern between the levels of the COVID-19 virus in the wastewater and the number of COVID-19 cases reported in the five cities. More specifically, wastewater data follow the upward and downward trends of the local number of infections. Overall, these results indicate that wastewater analysis is a low cost approach that could help inform emerging local pandemic trends by complementing clinical surveillance. The science continues to evolve, and we will continue to monitor these changes and update wastewater data regularly.

Waves of the pandemic look similar between wastewater and clinical cases

Although health region boundaries do not align exactly with the areas served by the wastewater treatment plants, a high level analysis of wastewater data versus clinical cases found through municipal or provincial dashboards showed that the two data sources paint a similar picture of the epidemic.

In Metro Vancouver, for example, wastewater results show the largest wave was in April 2021 followed by a smaller wave which peaked at the end of August. Similarly, clinical results from the British Columbia COVID-19 dashboard indicate that the third wave peaked in early- to mid-April, while the fourth wave peaked in late August or early September, and that the extent of the third wave was much higher than the fourth.

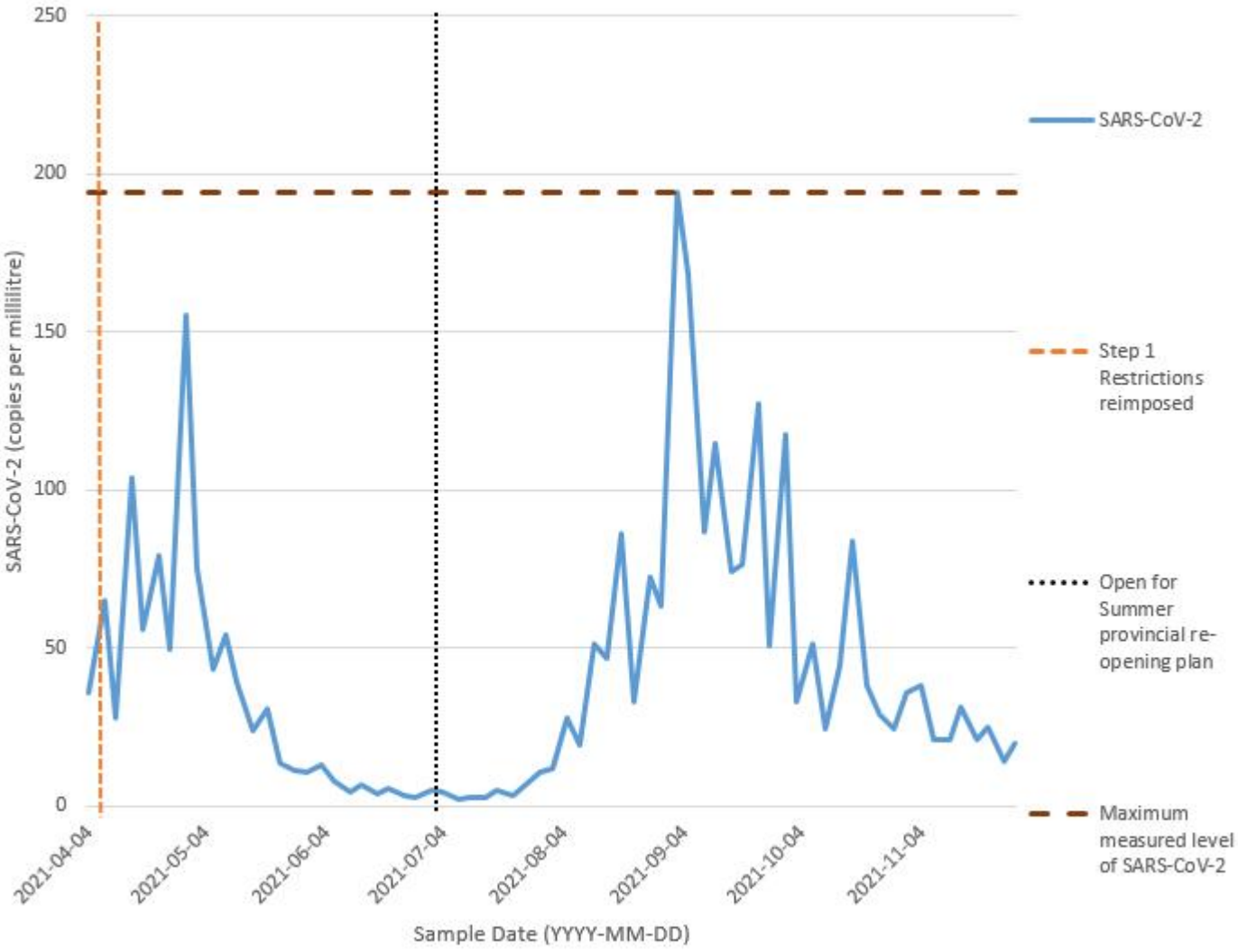
Infographic 1 – SARS-CoV-2 levels in Metro Vancouver wastewater



Note: The scale of the y-axis, SARS-CoV-2 (copies per millilitre) is different for each city.
Source: Canadian Wastewater Survey, 2021.

The story in Edmonton was much the same. Wastewater data show the peaks occurred at roughly the same times as Metro Vancouver. Clinical data from the COVID-19 in Edmonton: Day by Day website shows similar results. However, in the clinical dataset, the third wave was slightly bigger than the fourth.

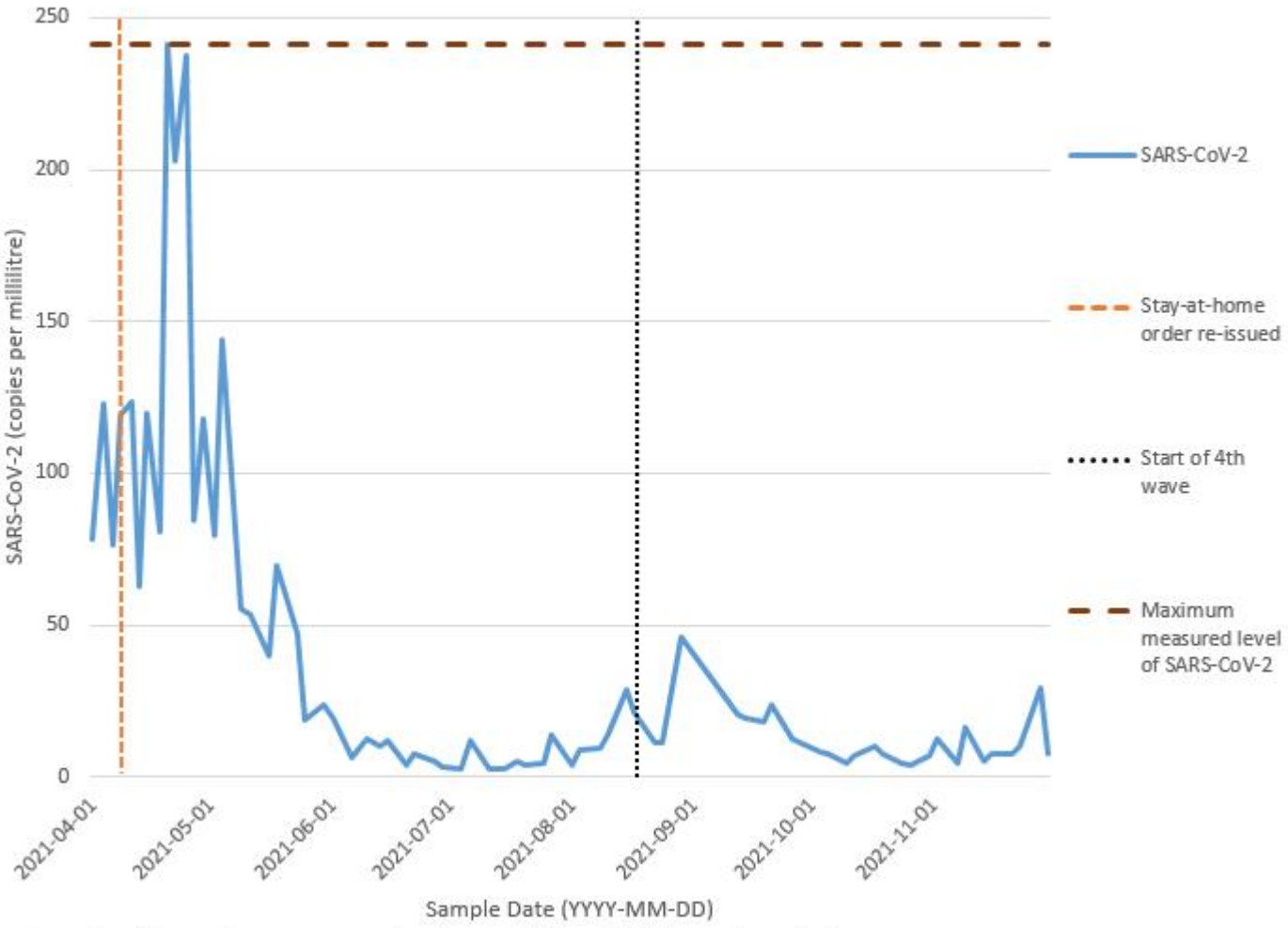
Infographic 2 – SARS-CoV-2 levels in Edmonton wastewater



Note: The scale of the y-axis, SARS-CoV-2 (copies per millilitre) is different for each city.
Source: Canadian Wastewater Survey, 2021.

According to wastewater results, Toronto was more similar to Metro Vancouver where the third wave was much bigger than the fourth, but in Toronto, the difference was even more pronounced. Again, these align with clinical results presented in Toronto Public Health's COVID-19 Monitoring Dashboard, where the highest number of daily cases was in April 2021, followed by a much smaller wave in the fall.

Infographic 3 – SARS-CoV-2 levels in Toronto wastewater



Note: The scale of the y-axis, SARS-CoV-2 (copies per millilitre) is different for each city.
Source: Canadian Wastewater Survey, 2021.

The peak for levels of the SARS-CoV-2 virus in Montréal wastewater was prior to April 2021, and is therefore not presented, but the trends since April 2021 are in line with results on the Santé Montréal Epidemic curve of confirmed cases of COVID-19.

The level of the SARS-CoV-2 virus in wastewater follows the imposing and lifting of public health measures

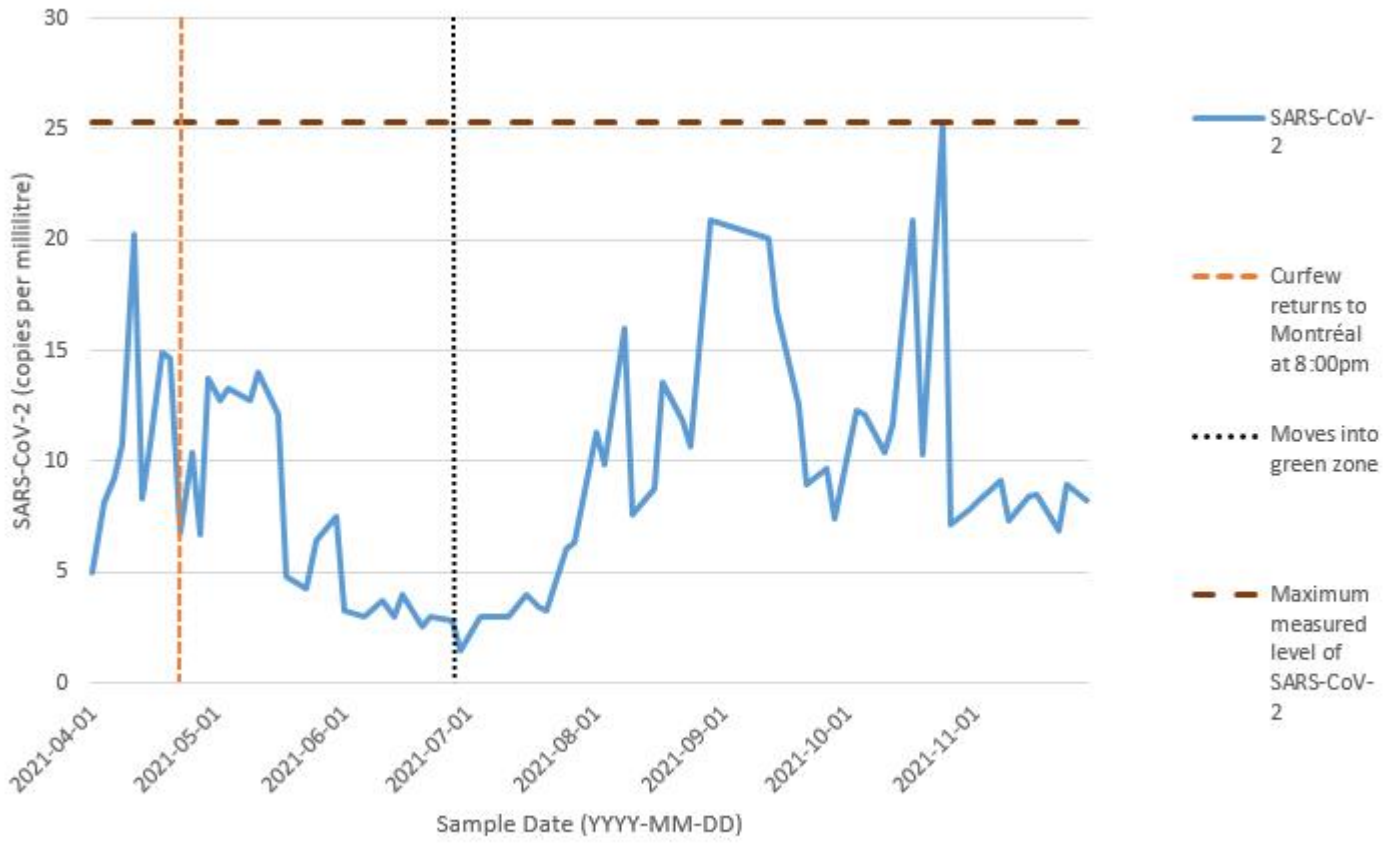
Results from all five cities show levels of SARS-CoV-2 virus in wastewater decreasing following the introduction of public health measures during the third and fourth waves, while easing of restrictions showed an opposite pattern. For example, when British Columbia declared the third wave of the pandemic on April 13, 2021 based on rising clinical cases, levels of SARS-CoV-2 measured in Metro Vancouver wastewater samples were at their maximum. Following the introduction of public health measures, such as travel restrictions, and as vaccination rates continued to increase, the levels in wastewater declined. Public health restrictions in British Columbia were slowly eased in

the spring of 2021, after which, levels of the SARS-CoV-2 virus in wastewater steadily increased. In late August, public health measures, including an indoor masking mandate, were then re-imposed, and the levels of the virus in wastewater began to decrease until the end of the reference period in November.

The story in Edmonton is quite similar. Like British Columbia, Alberta returned to Step 1 of its provincial reopening framework in early April 2021 due to the rise in clinical cases, which coincided with increasing levels of SARS-CoV-2 in Edmonton's wastewater. The signal peaked during the last week of April and rapidly declined as subsequent province-wide restrictions were imposed and vaccination rates increased. Levels of the virus remained low throughout June, and the province proceeded with its "open for summer" plan on July 1, which saw an easing of most public health measures. Subsequently, case counts and levels of the virus started to increase again, as the fourth wave started and peaked during the first week of September.

Montréal is another example of how the levels of SARS-CoV-2 in wastewater follow the tightening and relaxing of public health restrictions. Levels of SARS-CoV-2 in wastewater samples started to increase again in April 2021. A curfew was declared in Montréal on April 11 as a result of the high case counts. Vaccination rates then began to increase throughout the spring, following which, the viral load in wastewater began to rapidly decrease. Quebec eased restrictions and moved into the "green-zone" of its reopening plan on June 29, which coincided with the lowest viral loads in Montréal wastewater. However, following this, the viral load began to increase by late summer, and appears to have peaked in October.

Infographic 4 – SARS-CoV-2 levels in Montréal wastewater

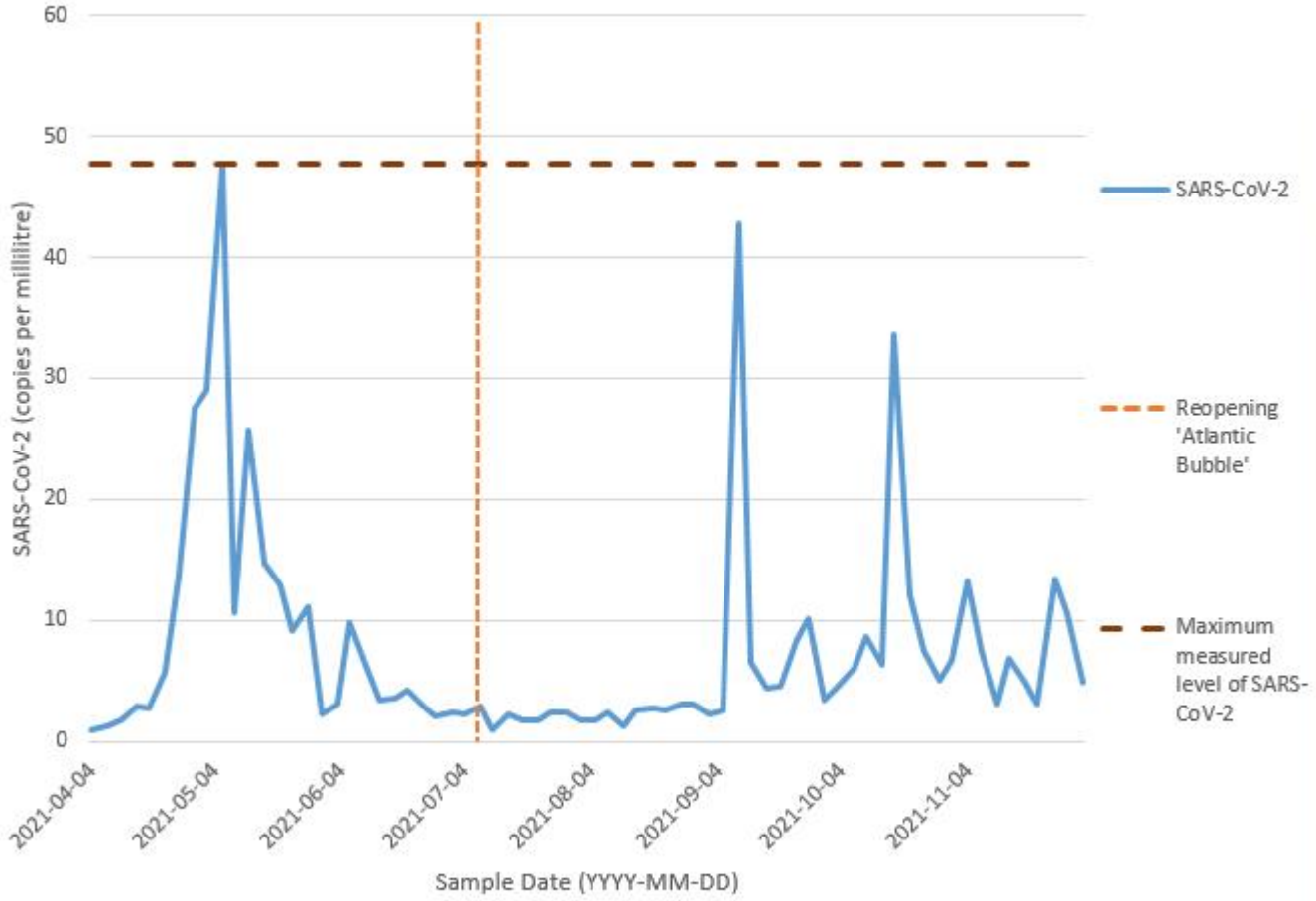


Note: The scale of the y-axis, SARS-CoV-2 (copies per millilitre) is different for each city.
Source: Canadian Wastewater Survey, 2021.

Levels of SARS-CoV-2 in Toronto wastewater samples had already begun to increase heading into April 2021. Ontario entered a province-wide shut-down on April 3, followed by declaration of the third provincial state-of-emergency and a re-issue of the stay-at-home order on April 8. The wastewater signal peaked during the last week of April and rapidly declined, coinciding with the imposition of province-wide restrictions and the increase of vaccination rates. The viral load was at its lowest from June to August but began to increase as the province declared the fourth wave of the pandemic on August 17. A proof-of-vaccination system was implemented by the province starting September 22, after which levels in wastewater remained relatively low through the end of the study period (November 2021).

In Halifax, the highest level of SARS-CoV-2 was measured during the first week of May 2021, followed by a rapid decline as vaccination rates increased. The amount of virus in wastewater was the lowest from mid-June to the end of August. In general, wastewater virus signals in Halifax were low. This mirrors the clinical data, as case rates were also lower in Nova Scotia than the other provinces.

Infographic 5 – SARS-CoV-2 levels in Halifax wastewater



Note: The scale of the y-axis, SARS-CoV-2 (copies per millilitre) is different for each city.
Source: Canadian Wastewater Survey, 2021.

Collaboration with PHAC allows for surveillance of emerging variants of concern and modelling of pandemic trends

In December 2020, the Alpha variant (B.1.1.7), first identified in Britain, was declared a variant of concern by the World Health Organization. The StatCan-PHAC program provided a continuous source of wastewater samples and data to PHAC scientists, as they developed both genomic sequencing-based and genotyping PCR-based methods to track variants of concern in wastewater. Following this development, and with guidance from PHAC scientists, similar methods are now being used in other municipalities across Canada. In addition, the Canadian Wastewater Survey is an ongoing data source for epidemiologists to develop models that integrate wastewater and clinical data so that public health officials can use the results for actionable outcomes.

Other release products

PHAC COVID-19 wastewater results are being released through the National Collaborating Centre for Infectious Disease (NCCID) website. The NCCID specializes in forging connections between those who generate and those who use infectious disease public health knowledge, and is hosted by the University of Manitoba. Working across disciplines, sectors and jurisdictions, they are uniquely situated to facilitate the creation and operation of networks and partnerships.

Note to readers

The Canadian Wastewater Survey (CWS) has been estimating levels of various licit and illicit drugs in the wastewater of five Canadian cities since 2019. Wastewater-based epidemiology applies analytical techniques to wastewater in order to estimate consumption of substances, exposure to pollutants, and/or levels of pathogens or antimicrobial resistance at the community level.

At the onset of the COVID-19 pandemic in 2020, it quickly became apparent to the scientific community that, due to the shedding of the virus in human stools, SARS-CoV-2 could be detected and quantified in wastewater. Indeed, individuals infected with SARS-CoV-2, even when asymptomatic, often shed the virus in their stool.

Since fall 2020, Statistics Canada has collaborated with the Public Health Agency of Canada (PHAC) on a wastewater-based epidemiology program to detect and monitor levels of SARS-CoV-2 in the wastewater of the same five Canadian cities as the CWS, representing close to 8.7 million Canadians.

Wastewater analysis can complement other epidemiological indicators on the burden of COVID-19 (such as number of hospitalizations) while being timely, cost effective (one test per community versus many tests) and easy to deploy, especially to remote areas where resources to carry on systematic clinical testing can be limited. It continues to be an important indicator of the course of the pandemic that complements clinical data.

Limitations

Despite the advantages listed above, there are some methodological and analytical limitations to the approach, meaning the results should be interpreted with caution:

- *Samples are only collected twice weekly which, while maintaining accuracy regarding overall trends, can limit data interpretation and trend modelling in narrow time frames.*
- *There are limitations associated with analytical aspects:*
- *1) Estimates of viral load are greatly affected by normalization techniques when using different indicators of the levels of fecal content in the wastewater. Data presented here were not normalized as researchers are still debating the best approach.*
- *2) Some variability has been observed when different fractions of the same wastewater sample are repeatedly analyzed.*
- *3) External factors such as the weather can have important effects. Year-long differences in ambient temperature will affect how stable the virus genomic particles are in wastewater, impacting accuracy during warm months. Snowmelt, flooding, excess rainfall, and drought conditions will contribute to dilution/concentration of viral signal.*

Given the nature of these limitations, results between individual cities should not be compared at face value. The results shown in Infographics 1 to 5 of this article are scaled from zero to the highest measured level of SARS-CoV-2 in wastewater in their respective city during the current reference period. The results shown are not normalized to a specific parameter due to the continued challenges with respect to the methodologies.

Definitions, data sources and methods: survey number 5280.

The Canadian Wastewater Survey data for the period from April 1 to November 30, 2021 are now available upon request.

For more information, or to enquire about the concepts, methods or data quality of this release, contact us (toll-free 1-800-263-1136; 514-283-8300; **infostats@statcan.gc.ca**) or Media Relations (**statcan.mediahotline-ligneinfomedias.statcan@statcan.gc.ca**).